

CAPE EXPEDITION—SCIENTIFIC RESULTS OF THE NEW ZEALAND
SUB-ANTARCTIC EXPEDITION, 1941-45

FRESHWATER FISHES FROM THE AUCKLAND AND CAMPBELL ISLANDS

by

G. STOKELL



*Issued under the authority of the Hon. K. J. Holyoake
Minister of Scientific and Industrial Research*

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FOREWORD

THIS SERIES OF REPORTS is based in the main on collections of specimens and data made at the Auckland and Campbell Islands in the years 1941-45. Early in 1941, coast-watching stations were established at Port Ross, Carnley Harbour, and Perseverance Harbour, and the personnel of from three to five men at each were relieved only once a year. Standing instructions issued by Navy Office included a recommendation that the men should, in addition to service routine, record general observations on natural phenomena. In making a selection of suitable volunteers, the Aerodromes Branch of the Works Department was able from 1942 to post at each station at least one man with some professional qualifications in geology or biology. The names of most of them are given below in the list of committee members, but the collections were enriched by the work of many others who made no claim to professional status as naturalists.

In 1944, coast-watching was abandoned and the Auckland Islands stations closed, but in that year special opportunities were given for visits to the Snares and Disappointment Island. The Campbell Island station was continued for routine meteorological reporting and ionosphere research, but, except for the inclusion of a report on Aurorae as number one of this series, all results of this work are published elsewhere. Biological and geological material collected after 1945 has not generally been included, and these reports may be regarded as covering the work of the "Cape Expedition" which was the war-time code name for parties in the field between 1941 and 1945.

Arrangements for the writing of reports and for publication have been dealt with by a committee consisting of Dr. H. H. Allan (Chairman), Dr. J. Marwick, the Directors of Auckland, Dominion, Canterbury, and Otago Museums, and the following field collectors: C. A. Fleming, J. H. Sorensen, W. H. Dawbin, E. G. Turbott, and R. W. Balham. The Committee is indebted to authors who have undertaken to prepare reports, and to Mr. F. R. Callaghan, Secretary of the Department of Scientific and Industrial Research, and to his staff, for arrangements for publication.

R. A. FALLA,

*Hon. Secretary, Cape Expedition
Reports Committee.*

FRESHWATER FISHES FROM THE AUCKLAND AND CAMPBELL ISLANDS

By G. STOKELL

(Manuscript received by Cape Expedition Committee on 17th April, 1948)

INTRODUCTION

THE MATERIAL received from the Auckland Islands and Campbell Island consists of a single species of *Galaxias*, distinct from any known to occur on the mainland of New Zealand. The absence of *Galaxias attenuatus* is noteworthy, as this is the most widely distributed Galaxiid species, and in South America extends to the south of the latitude of the present locality. The Subantarctic Islands expedition organised by the Canterbury Philosophical Institute in 1907 brought back only the single species obtained by the present expedition, but in neither case does the collecting appear to have been sufficiently intense to justify the conclusion that *attenuatus* is absent from the locality. This species is recorded from river mouths and lowland waters throughout the mainland of New Zealand and from several outlying islands. In Australia it is recorded from Southern Queensland, New South Wales, Victoria, Tasmania, and Lord Howe Island, and in South America from Chili, Patagonia, Tierra del Fuego and the Falkland Islands. Its occurrence in the Falkland Islands is of particular interest, as these islands are at about the same latitude as the Auckland Islands, and the two groups do not differ greatly in distance from their respective mainlands. It has been established that *attenuatus* spawns in fresh water near the mouths of rivers and that the young disappear into the ocean shortly after being hatched, to return later as whitebait, but the duration of this period of marine existence and the distance travelled at sea are unknown.

The problem of Galaxiid distribution has engaged the attention of many zoologists, but none of the explanations that have been advanced is satisfactory. The popular hypothesis of derivation from marine congeners, which is usually put forward without either the presentation of supporting evidence or a consideration of the circumstances that tend to discredit it, introduces problems almost as great as the one it attempts to solve. No attempt has been made to explain the *independent* adoption of a freshwater habit in each of several countries and the subsequent extinction of the ancestral forms *in three oceans*. If marine Galaxiids had been so well established as to have extended through the area involved, it might be expected not only that they would have persisted till the present time, but that they would have exceeded their freshwater derivatives in number of species. The position is, however, that of the forty or more species that appear to be authentic, only one (*attenuatus*) is known to enter the sea, and that one spends only part of its life therein.

A still more untenable hypothesis involving marine origin but not requiring the extinction of the ancestral form is that *Galaxias* has arisen independently from marine ancestors in each country in which the genus is represented. It is difficult to imagine how forms separated by only the finest specific distinctions can owe their existence to independent evolution. Certain species from Australia differ from New Zealand species in no greater degree than New Zealand species differ from each other; they repeat the same individual characters and are distinguished princi-

pally by different combinations. The closeness of the resemblance of certain species from New Zealand, Australia and South America seems unexplainable except on the grounds of congeneric ancestors. It is also to be noted that no marine group from which the Galaxiids may be conceived to have evolved is apparent, and that the closest relatives of the family are freshwater dwelling.

If the contention of marine origin of the Galaxiidae is examined apart from considerations of distribution a remarkable paucity of supporting evidence is revealed. Analogy with Salmonidae, the favourite resort of authors who subscribe to this view, merely shifts the discussion to the latter family, in which evidence of marine ancestry is equally unsatisfactory. Paleontology lends no support to the theory of marine origin, as the only fossil *Galaxias* recorded (Oliver, 1936, and Stokell, 1945) are associated solely with freshwater and terrestrial material.

Another explanation of distribution is that freshwater *Galaxias* might migrate by marine routes, and that the distances separating the several countries inhabited by them are not insuperable barriers to dispersal. If these fishes were capable of being transferred from one country to another some interchange of species must have resulted, but apart from *attenuatus*, no species is known to occur in two or more faunal areas. The fact that all freshwater species in areas such as New Zealand, Australia, South America, and South Africa are endemic suggests that these areas have been isolated for a period sufficient for the evolution of distinct local species. Some areas separated by the sea carry identical freshwater species, but most of these areas are not widely separated and the circumstances do not preclude the possibility that they were once connected. Three freshwater species are common to the North and South Islands of New Zealand, two of which—*fasciatus* and *alepidotus*—are lowland forms which range so close to the sea that they might be conceived even to enter it, but the third—*lynx*—is an inhabitant of alpine lakes and seems unlikely to be capable of traversing Cook Strait. One of these species—*fasciatus*—is recorded from the Chatham Islands, which are about 360 miles from New Zealand, but the suggestion that these islands have been colonised by sea migration from the mainland is greatly weakened by existing evidence that the two localities were once connected.

The theory of past connection of all countries in which Galaxiidae is represented forms the basis of another school of thought on the distribution of these fishes. Some form of land connection does seem necessary to explain the circumstances outlined above, and while such an explanation involves considerable geological difficulties, these difficulties become less formidable if the hypothesis of drifting continents advanced by Du Toit is substituted for the usual conception of connection by way of Antarctica. Whatever form of connection is postulated, it is essential that it should have been maintained until Galaxiidae was evolved. This seems unlikely to have occurred before the Miocene, as the osteological features of the group suggest that its true position is in the order Haplomi instead of in the more primitive Isospondyl, in which some workers have placed it.

The absence of Eleotrids from the present material must also be noted, as this group forms an important part of the freshwater fauna of the mainland. Eleotrids occurs at the extreme south of the South Island of New Zealand, and so far as is known, this is their most southern world locality. Whether they are capable of extending farther south is not deducible from the present evidence, but it seems likely that the south of New Zealand approximates the southern limit of their potential range, as the group is widely distributed in the tropics, and the temperate forms appear to have been derived from tropical regions.

On the other hand, Retropinnidae, which also is absent from the collection, is essentially a southern group. This family is restricted to Australia and New Zealand, its latitudinal range being from southern Queensland to the extreme south of the South Island of New Zealand. It is strongly represented at the southern extremity of its range and would thus appear to be capable of extending much farther south if suitable habitats were available. The purely freshwater species occur in lakes at considerable altitudes, and would find no suitable habitat on the Auckland and Campbell Islands, but the estuarine and coastal forms, which constitute the greater part of the family, might be expected to occur in such localities as Carnley Harbour, if estuaries of suitable character were available. The species that have been investigated spawn in fresh water, some within tidal influence and some at a considerable distance above it, but still in comparatively slack water. The stream at North Arm, Carnley Harbour, is described as having a well-developed estuary with tidal activity extending some distance upstream, and would therefore appear to provide a suitable habitat for several mainland species of Retropinnidae. The failure of these fishes to stock the locality as it now exists suggests inability to traverse the intervening ocean. It might be expected that the means of distribution responsible for the occurrence of Retropinnidae in such widely separated countries as Australia and New Zealand would have been sufficient to extend the family to the Auckland Islands, and it is possible that it was once represented there. The Auckland Islands appear to have been glaciated to such an extent as to have rendered the area that now exists untenable by freshwater and estuarine fishes, but geological evidence indicates that at this time the islands were much higher than at present, and it seems possible that their marginal areas, now submerged, were sufficiently extensive to have provided habitats for both types. Both *Retropinna* and the present species of *Galaxias* may have existed in the Auckland Islands before their subsidence, and the estuarine fish may have been exterminated when its habitat disappeared while the freshwater one was able to survive in the streams that might well have persisted after the estuaries were drowned.

Another family that might be expected to be represented at the Auckland Islands, and has in fact been recorded from there, is Anguillidae. Richardson described *Anguilla aucklandii* (preceded by *A. deffenbachi* Gray) from the Auckland Islands and also recorded *A. australis*, but both species seem to have escaped the observation of all later collectors.

SYSTEMATIC

Four species of *Galaxias* have been described from the Auckland Islands and Campbell Island, and three other names have been associated with the locality by synonymy. The first species recorded from the Auckland Islands are *brocchus* Richardson (1848) and *reticulatus* Richardson (*loc. cit.*), both of which are described as having the length of the head contained four times in the standard length, while in the present species the ratio ranges from 4.45 to 4.9. The total length of Richardson's specimens, which is recorded as $8\frac{1}{2}$ inches for *brocchus* and 6 inches for *reticulatus*, forms a further bar to the admission of the present fish, in which the maximum total length observed is 5.9 inches. These comparisons appear the more significant when consideration is given to the difference in size of the respective

collections. Richardson stated with reference to *reticulatus* that there were other specimens in addition to the two that he particularly described, but recorded only two of *brocchus*. In addition to the present material the writer has examined the collection obtained by the expedition organised by the Canterbury Philosophical Institute in 1907, the whole totalling over seventy specimens. The absence of any specimen equalling the sizes given for *brocchus* and *reticulatus* suggests that the recorded localities of these species may be incorrect and that the specimens may have come from the mainland, which members of the *Erebus* and *Terror* expedition certainly visited. Until the types are re-examined and a systematic search of the locality is conducted, the position of these species must remain in doubt. Gunther (1866) referred both to *fasciatus* Gray (1842), but so far as *reticulatus* is concerned this identification is scarcely satisfactory, as the figure of this species indicates a longer caudal peduncle than has been observed in *fasciatus* from any locality.

In 1880 Sauvage described a specimen 60 mm. in length from Campbell Island under the name of *campbelli*, the description indicating a fish with a head in standard length ratio of 6.5 and a pectoral fin extending half of the distance from its root to the ventral. Regan (1905) referred this fish to *attenuatus*, and this course was followed by Waite (1909), who, solely on this erroneous identification, included *attenuatus* in his list of fishes of Campbell Island. In order to determine the position of this species the writer applied to Dr. Leon Bertin, of the Museum National d'Histoire Naturelle, Paris, who, in addition to supplying measurements of the five co-types, generously forwarded one of them for examination. All of these specimens are small, the available example having a standard length of only 40.5 mm. This fish agrees precisely with juvenile examples of the only form known from the Auckland Island and Campbell Island. The vertebrae number 60, the branchiostegals 7, the anal fin rays 14 (all counted), the head is contained 5.4 times in the standard length, the ventral fin is inserted at 0.49 of same, the pectoral extends 0.58 of the distance from its axil to the ventral, and the ventral extends 0.62 of the distance from its root to the origin of the anal, all of which specifications come within the range of variation of the present species. In this fish the point of ventral insertion is more anterior in juveniles than in adults, and the length of the head is relatively much shorter. The name *campbelli* is, therefore, the earliest that can be definitely associated with the Auckland Islands and Campbell Island fish, and is used in the present paper.

In 1901 Hutton described a single specimen from the Auckland Islands under the name of *bollansi*, and, on account of the fish having been taken from the throat of a merganser, recorded it as a marine species. Waite (1909), however, presented evidence to show that this bird is by no means restricted to sea-feeding, and gave a very necessary check to the tide of distributional speculation that was rising as a result of the supposed discovery of a truly marine *Galaxias*. The type of *bollansi* is in the British Museum and has been subjected to X-ray examination by Dr. Ethelwynn Trewavas of that institution, to whom the writer wishes to express his thanks. The X-ray negative and specifications forwarded by Dr. Trewavas indicate a fish 4.2 inches in total length with 62 vertebrae, 12 dorsal rays (all counted), 13 anal rays, and agreeing also in other characters with the Auckland Islands fish. The head in standard length ratio is rather low, but this is accounted for by the contortions visible in the vertebral column, which suggest that the body has been shortened by constriction in the bird's throat. The name *bollansi* Hutton therefore becomes a synonym of *campbelli* Sauvage.

Waite (1909), who examined a considerable collection from the Auckland Islands and Campbell Island, referred the fish to *brevipinnis* Gunther (1866), with which species Regan had identified the type of *bollansi*. The species *brevipinnis* is described as having 65 vertebrae, a head in standard length ratio of 5, dentition similar to that of *fasciatus*, an obtuse snout, a truncated caudal fin, a pectoral extending half or rather less than half of the distance from its root to the ventral, and a ventral terminating at a great distance from the vent. The present writer has been unable to find such a fish in New Zealand waters or in museum collections. The species most nearly approaching the requisite number of vertebrae are *attenuatus* (61-63) and the present species (59-64), the first of which differs so greatly from the description of *brevipinnis* as to require no further consideration. The Auckland Islands and Campbell Island species has yielded the highest individual vertebral count obtained by the writer, but it must be noted that no specimen with 65 has been observed and that 64 occurred only once in 29 specimens. The wide separation of the maximum number from the dominant number shown in the following frequency table indicates the improbability of any upward extension of the range.

Number of vertebrae	59	60	61	62	63	64
Number of occurrences	2	5	12	7	2	1

A head in standard length ratio of 5 has not been observed in the present species, the range obtained from the examination of a considerable number of specimens being 4.45-4.9. The present fish agrees with *brevipinnis* in so far that the dentition is similar to that of *fasciatus*, and large individuals agree in the form of the caudal fin, which in specimens over 5½ inches in total length becomes truncated or almost so, but it must be noted that adult fish of 4-5 inches have the caudal concave with rounded lobes. Gunther's specimens of *brevipinnis* are recorded as having a total length of 5-6 inches. A lack of agreement occurs in the form of the snout which, in the Auckland Islands fish, is less obtuse than in most New Zealand species, and in the length of the pectoral fin, which normally extends more than half of the distance from its root to the ventral. The examination of twenty-five specimens revealed one in which the fraction was less (0.45), but the abdomen of this fish was abnormally distended and the ventral fins had been forced downward and backward, thus unnaturally increasing the pectoral-ventral interspace.

Gunther's statement that the ventral fin of *brevipinnis* "terminates at a great distance from the vent" is rather indefinite, but a clue to its interpretation is provided by the same author's statement that in *fasciatus* the ventral terminates "a short distance from the vent." Measurement of a series of specimens of *fasciatus* has shown that in this species the distance from the tip of the ventral to the vent ranges from 0.18 to 0.33 of the distance from the root of the ventral to the vent, while in the Auckland Islands fish the corresponding ratios are 0.28-0.40. The distances represented by these values are too similar for Gunther to have made such a distinction between them as to have referred to one as short and the other as great. In the truly short-finned forms such as *attenuatus* the value is about 0.62.

Further circumstances discrediting the identification of the Auckland Islands fish with *brevipinnis* are the original locality of the latter species, which is recorded as "New Zealand," no mention being made of outlying islands, and the fact that the present species has not been found on the mainland. Gunther's specimens of *brevipinnis* were presented by Captain Stokes, who also presented specimens of

fasciatus and *alepidotus*, both of which are lowland species. It would thus appear that *brevipinnis* could be sought with the greatest chance of success in localities close to the sea.

Galaxias campbelli Sauvage

Galaxias campbelli Sauvage. *Bull. Soc. Philomatique*, ser. 7, vol. iv, p. 229, 1880.

Galaxias bollansi Hutton. *Trans. N.Z. Inst.*, vol. 34, 1901.

Galaxias brevipinnis Waite. *Sub-Antarctic Islands of N.Z.*, vol. 2, 1909.

B. 7-9. Div.-v. 7-9. A. v-vi. 8-9. V. 7. Vertebrae (without hypural) 59-64. Lower jaw somewhat the shorter with strong lateral canines, upper with moderately enlarged canines, entopterygoid teeth moderate, 6-7 on each bone, gill rakers moderate, pyloric caeca well developed. Maxillary extending to below middle of eye. Head 4.45-4.9 in standard length, dorsal fin inserted at 0.70-0.75 of the standard length, least depth of tail 0.5-0.6 of the distance from the rear or dorsal to base of caudal. Caudal fin moderately concave with rounded lobes becoming almost convex in very large specimens. Pectoral extending 0.54-0.68 of the distance from its axil to the ventral, ventral inserted at 0.48-0.55 of the standard length, extending 0.60-0.68 of the distance from its root to the origin of anal, anal originating below 5th-6th dorsal ray (all counted). Branched rays of anal bifid.

Maximum total length observed, 5.9 inches.

Localities: Several streams on the Auckland Islands and Campbell Island.

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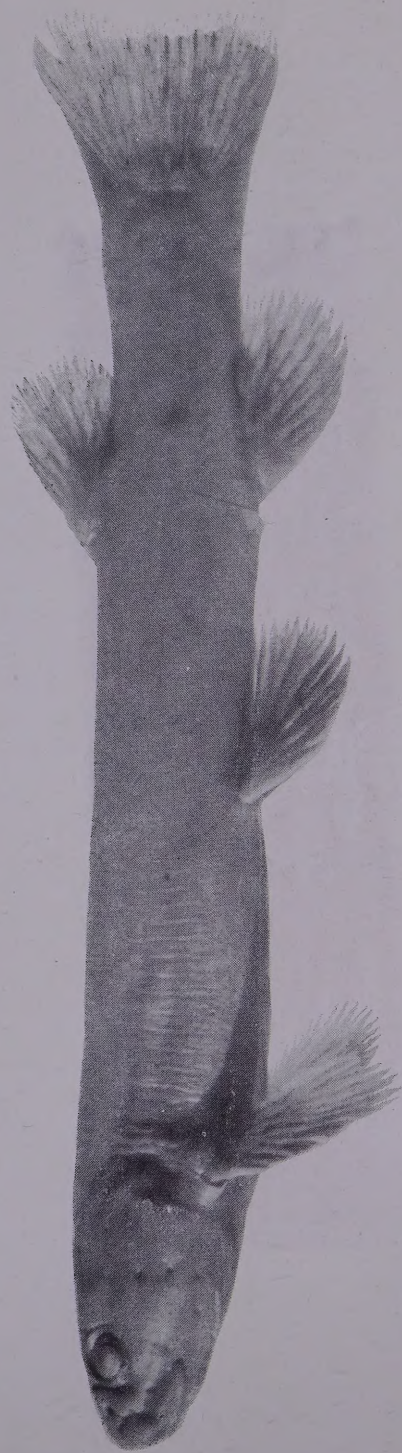
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Galaxias campbelli

Creek in Garden Cove, Perseverance Harbour, Campbell Island.

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